MODEL CALIBRATION/VALIDATION

Calibration/Validation is an iterative process — upgrading or adjusting entered data, program coefficients or parameters, and assumptions on successive simulation runs, until the volumes and traffic patterns produced by the model approximate known traffic counts within acceptable limits. The primary reason behind validation is that simulated model data should not significantly differ from actual count data to cause inappropriate under- or over-design of roadway facilities. However, the percent difference between modeled volumes and actual counts may be large, but is only significant in relation to its functional classification and the magnitude of the volume itself. The following performance measures were reviewed:

- Percent assignment error
- Root Mean Square error
- Coefficient of Determination; RSquared (R^2)
- Screenline analysis

Percent Error of Traffic Assignment

The percent error of traffic assignment indicates the accuracy with which the transportation model replicates the actual traffic counts. Percent error is the difference between the assigned traffic volumes and the counted traffic volumes divided by the counted traffic volumes. Table 24 displays the percent error by functional classification for Lincoln MPO model.

TABLE 24. PERCENT ERROR BY FUNCTIONAL CLASSIFICATION

FUNCTIONAL CLASS	SUM OF COUNTS	SUM OF ASSIGN	NUMBER OF COUNTS	PERCENT ERROR	PERCENT ERROR TARGET*
Collector	267,981	214,851	51	-19.83%	25.0%
Interstate/freeway	352,200	349,309	21	-0.82%	7.0%
Major Arterial	1,291,935	1,327,761	58	2.77%	10.0%
Major Collector County	69,119	78,299	44	13.28%	25.0%
Minor Arterial	4,693,779	4,649,079	364	-0.95%	15.0%
Principal Arterial (Div)	927,313	962,444	76	3.79%	10.0%
Average Network Stats	7,602,327	7,581,743	614	-0.27%	5.0%

"Calibrating and adjustment of system planning models" December 1990, FHWA

Root Mean Square Error

Another measure of the model's ability to assign traffic volumes is the percent RMSE. The RMSE measures the deviation between the assigned traffic volumes and the counted traffic volumes and is given as:

$$\%\ \text{RMSE} = \frac{100 * \sqrt{\frac{\sum_j (Model_j - Count_j)^2}{(Number\ of\ Counts - 1)}}}{\left(\frac{\sum_j Count_j}{Number\ of\ Counts}\right)}$$

A large percent RMSE indicates a large deviation between the assigned and counted traffic volumes; whereas, a small percent RMSE indicates a small deviation between the assigned and counted traffic volumes. Usually, lower volume roads shows bigger percent RMSE and higher volume roads shows smaller percent RMSE. The percent RMSE by facility type is given in Table 25.

TABLE 25. PERCENT RMSE BY FUNCTIONAL CLASSIFICATION

FUNCTIONAL CLASS	PRMSE	PRMSE TARGET
Collector	43.40%	100.0%
Interstate/freeway	10.08%	15.0%
Major Arterial	13.94%	30.0%
Major Collector County	42.10%	100.0%
Major Collector State	n/a	100.0%
Minor Arterial	23.02%	45.0%
Minor Collector (Rural)	n/a	100.0%
Principal Arterial (Div)	14.75%	30.0%
Ramps	n/a	100.0%
Average Network Stats	21.46%	35.0%

Coefficient of Determination

Another tool to measure the overall model accuracy is the coefficient of determination or R^2 (see formula below). The R^2, or "goodness of fit" statistic shows how well the regression line represents the assignment data. The very desirable R^2 is 0.88 or higher. A value of 1.00 is perfect, but even if traffic counts were compared against themselves, the daily variation would

not allow for a regression coefficient of 1.00. The value of 0.90 achieved for the Lincoln MPO illustrates that the model validation is also good.

$$r^2 = \left(\frac{n\sum(x_i y_i) - (\sum x_i)(\sum y_i)}{\sqrt{\left[n\sum x_i^2 - \left(\sum x_i\right)^2\right]\left[n\sum y_i^2 - \left(\sum y_i\right)^2\right]}} \right)^2$$

where: x = counts
y = model volumes
n = number of counts

Screenline Analysis

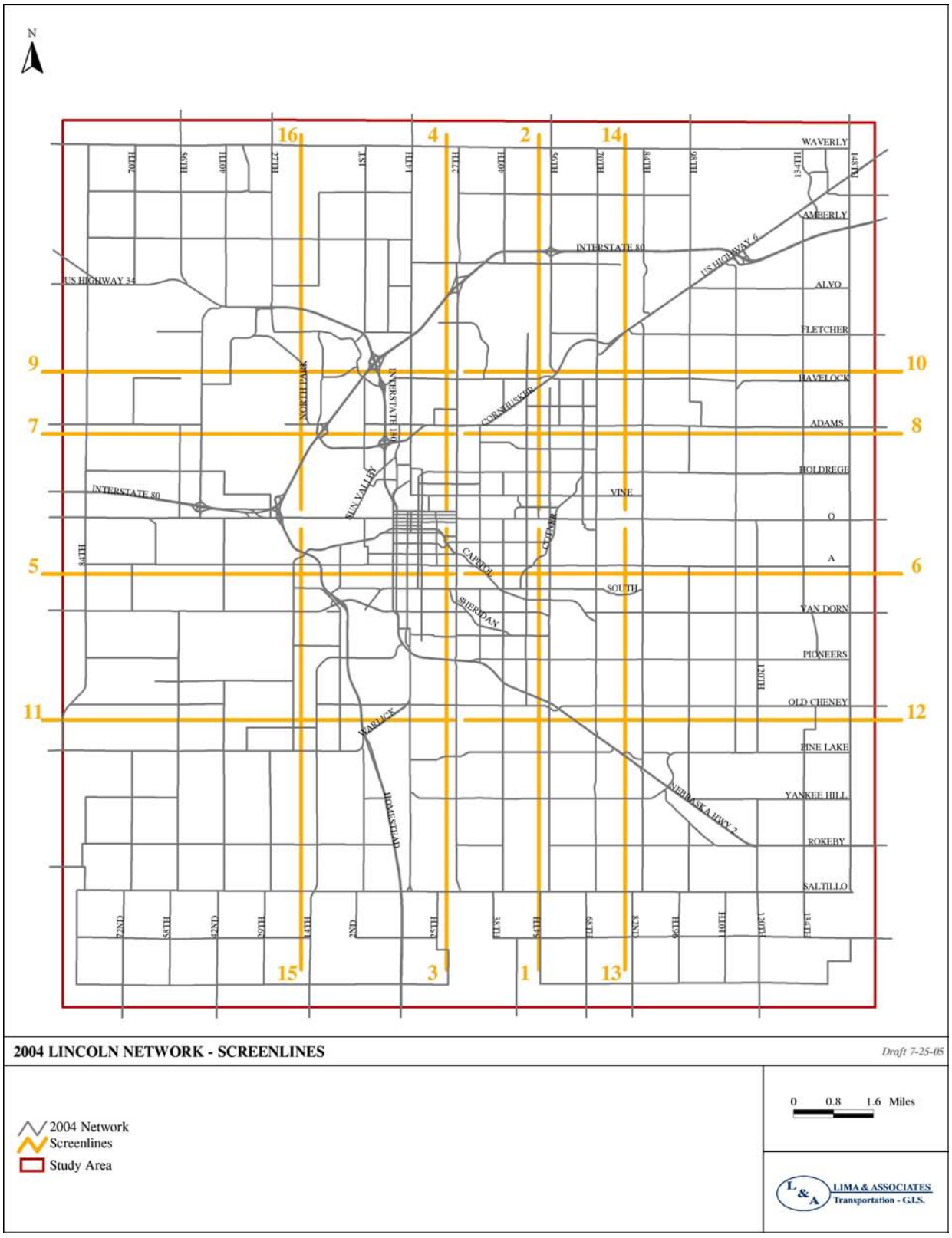
There are 16 screenlines in the Lincoln MPO model. Screenlines are imagery lines drawn across several sections of various roadways to assess the performance of the model by comparing the total model assigned volumes and total actual counts for those roadway sections. Figure 17 shows the location of screenlines used in the Lincoln MPO model. Table 26 shows the screenline analysis results.

TABLE 26. SCREENLINE ANALYSIS RESULTS

Screenline	Model Assigned Volume	Actual Count	Percent Difference
1	116,428	129,977	5.63
2	107,766	106,621	-1.06
3	163,562	163,594	0.02
4	157,019	156,926	-0.06
5	104,183	110,158	5.74
6	102,276	97,368	-4.80
7	56,510	53,778	-4.83
8	90,927	95,426	4.95
9	58,467	52,726	-9.82
10	50,477	48,014	-4.88
11	27,300	27,743	1.62
12	76,906	73,074	-4.98
13	65,494	72,476	10.66
14	54,253	53,876	-0.69
15	55,779	60,924	9.22
16	64,900	64,896	-0.01

Individual screenlines volume should have a comparison goal of plus or minus 10%.

FIGURE 17. SCREENLINE LOCATIONS FOR LINCOLN MPO MODEL



Vehicle Miles Traveled

The assigned 2004 daily traffic volumes were compared with the counted daily traffic volumes for individual links. The comparison indicated the following: 1) the computed vehicle miles traveled (VMT) in the study area are approximately 4,853,074 per day, 2) the estimated vehicle hours traveled (VHT) in the study area are approximately 119,311 per day. The VMT, and VHT do not include the centroid connectors or externals. The average trip length in the system using the system output data is anticipated to be approximately 5.4 miles in length. The VMT is in line with the projections made by the City of Lincoln in their 2004 assessment. Table 27 presents the VMT and VHT results by functional class produced by the Lincoln MPO model.

TABLE 27. 2004 VMT & VHT BY FUNCTIONAL CLASS

FUNCLASS	VMT	VHT
Collector	142,400	5,311
Interstate/freeway	770,642	12,109
Major Arterial	739,743	17,925
Major Collector County	113,192	2,084
Major Collector State	20,016	364
Minor Arterial	2,082,606	58,717
Minor Collector (rural)	9,454	191
Principal Arterial (Div)	860,728	19,560
Ramps	69,703	2,166
Others	44,590	884
TOTAL	4,853,074	119,311

Comparison of Results

The 1998 and the 2004 model were developed using different parameters, assumptions and characteristics. However, the comparison of certain variables and ratios independent of the model development process can be made. Table 28 displays the comparison's results.

TABLE 28. 1998 MODEL AND 2004 MODEL COMPARISON

Variable	1998	2004
Population	234,266	253,700
Dwelling Units (DU)	95,230	105,714
Vehicle Trips	844,220	906,526
Person Trips	n/a	1,478,358
Vehicle Trips/DU	8.87	8.58
Vehicle Trips/Person	3.60	3.57
Person Trips/ DU	14.36	13.98